DOCUMENT RESUME

ED 339 156 EC 300 766

| | |
|---|---|
| TITLE | Students with Severe and Profound Disabilities. Tech Use Guide: Using Computer Technology. |
| INSTITUTION | Council for Exceptional Children, Reston, VA. Center for Special Education Technology. |
| SPONS AGENCY | Special Education Programs (ED/OSERS), Washington, DC. |
| PUB DATE | Dec 90 |
| CONTRACT | 300-87-0115 |
| NOTE | 7p.; For related documents, see ED 324 842-850 and EC 300 758-769. |
| PUB TYPE | Guides - Non-Classroom Use (055) |
| EDRS PRICE | MF01/PC01 Plus Postage. |
| DESCRIPTORS | Accessibility (for Disabled); *Access to Education; *Computer Assisted Instruction; Educational Technology; Elementary Secondary Education; *Microcomputers; Multiple Disabilities; *Severe Disabilities; *Severe Mental Retardation; Teaching Methods |

ABSTRACT

This guide describes the assistance that modern technology and microcomputers can provide for individuals with significant cognitive disabilities who frequently have secondary physical, communication, or sensory impairments. Applications of technology can be made to increase access to learning for these students in the areas of motor training, mobility, environmental control, communication, and socialization. In addition to helping students become prepared to participate in instruction, technology can assist in delivering instruction. Specific prompting strategies can be employed to teach students how to focus attention on the critical features of the stimulus presented. Systematic reinforcement of correct responses is also important. Effective graphics can be incorporated into computer-assisted instruction and augmentative communication systems. Speech technologies, both speech synthesis and digitized speech, are also being used in instructional applications. The need for customizability of software and hardware is emphasized. A list of 20 readings, 4 organizations, 3 periodicals, and 10 product sources concludes the guide. (JDD)

Center for Special Education Technology

# Tech Use Guide

## Using Computer Technology



# Students with Severe and Profound Disabilities

The terms "severe" and "profound" refer to any disability that significantly limits a person's ability to perform daily tasks. The disability may be one of many or a combination of two or more disabilities. For the purposes of this guide, the person with severe or profound disabilities has a significant cognitive disability as the primary disability. Frequently there is an accompanying secondary physical disability affecting gross or fine motor muscle control; a communication disability affecting receptive or expressive language; or a sensory impairment affecting visual, auditory, tactual, or vestibular processing abilities.

Because the characteristics of students with severe disabilities are highly varied, it is difficult to find solutions to assist them in reaching a level of independence. Since the early 1980s, modern technology and the microcomputer have given these students a new set of tools, allowing them to achieve greater levels of independence. The technology brings the world within reach and makes instruction an activity worth pursuing.

## Access to Instruction and the World Beyond

Traditional instruction, which depends on auditory, written, and visual materials, must be adapted to the needs of people with severe disabilities. Technology allows for many adaptations by converting one medium to another or by accepting minimal responses for complex tasks. Technology provides a potential access to instruction that previously was unavailable.

One of the goals of every educational program should be to increase levels of independence. Areas of focus include communication, motor, vocational, social, and daily living skills. Technology can help achieve this goal in all areas, although current technology applications in the vocational and daily living areas are not common. The following is a description of some applications of technology to increase access to learning for students with severe and profound disabilities.

### Motor Training

Severe cognitive limitations are often accompanied by severe motor limitations, which inhibit students from participating in many school and other learning activities requiring hands-on interactions. The motor limitations may also extend to communicative motor movements, such as reaching and pointing or merely indicating yes and no.

A variety of switches are available that meet the motor needs of students with even the most severe disabilities. (A list of companies providing these switches can be found in the Resources section of this guide.) Switches come in six basic types: pressure, pneumatic, mercury, light, sound, and biofeedback. Pressure and light switches are most used for motor programs that emphasize reaching goals, pneumatic for breath-control goals, mercury for postural development goals, and biofeedback for specific muscle movement goals. Sound switches are not usually used for motor development purposes.

One basic application of the technology addresses these limitations. Simple microswitches can be used to encourage muscular development and specific motor movements. A battery-operated device can be connected to one of these switches to provide reinforcement to the student every time the switch is touched. One example is a pressure-type plate switch. By positioning the switch in places that will encourage reaching or other motor movements, teachers can supplement any motor training program to involve active exercises.

Different body parts can be used to activate these switches, depending on the switch design. Common motor movements for this type of training include limb extension (reaching, touching, pointing), eye blinking, breath control, and postural muscle control. For example, postural muscle development can be trained using a mercury switch that can be worn on a hat, headband, or barrette, and connected to a battery-operated device like a tape recorder. This type of switch responds to position change. When the student reaches the target position (e.g., sitting in midline), the switch activates the tape recorder, which provides reinforcement such as a favorite song or a few encouraging words from a parent or sibling.

For the more physically capable but cognitively impaired student, the technology offers opportunities for motor development as well. Motor training goals for this group usually emphasize motor coordination such as eye/hand coordination, accuracy of pointing skills, and finger/hand coordination in preparation for specific applications such as keyboarding.

Eye/hand coordination can be taught using the same simple microswitch technologies described previously, by

requiring coordination of the moveme .t task with some other event or action. However, the computer is the most common use of technology in this area. Simple gamelike programs are used to provide the student with practice in visual tracking and eliciting a coordinated motor response. For example, the anti-aircraft game on the *Motor Training Games* disk sends an airplane across the screen. The student must activate a switch (any design) while the plane is still on the screen.

Advancing beyond that basic skill, other programs teach the visual tracking of a scanning system, a selection system frequently used in early academic software and programs for augmentative communication (e.g., *Rabbit Scanner, Run Rabbit Run*). Still other programs are available to teach more advanced skills, such as keyboarding, using either the standard keyboard (e.g., *Letter Recognition, Dr. Peet's Talk/Writer*) or alternatives to keyboards (e.g., *Joystick Trainer*).

### Mobility

Battery-powered wheelchairs have been available for quite some time. They were originally operated by a series of buttons or a joystick. This has changed with the availability of microswitches. A person can now use any body part, no matter how small the movement, to activate the wheelchair. A switch-controlled wheelchair gives an individual with a severe or profound physical disability the opportunity to move independently.

### Environmental Control

One of the earliest concepts infants learn is the control of their environment. As children grow older, the things they want and need to control become more complex. Children with severe disabilities most often have limited opportunities to control the things around them because of their cognitive, verbal, and motor disabilities. Technology offers them control opportunities, beginning with teaching the most basic concept of control—cause and effect. Simple technologies can be used to control toys for young children and simple electrical devices for older people. Studies using these technologies have found that people with severe disabilities quickly demonstrate an understanding of the cause/effect relationship and quickly begin to show a preference for the kinds of objects they want to interact or play with. When provided the opportunity to control the environment and communicate their likes and dislikes, many students have been able to move themselves beyond their "learned helplessness" state. These newfound abilities to control devices in the environment and indicate preferences can later be integrated with other capabilities, such as verbal communication and mobility, into one system.

For the older student, the battery-operated toy can be substituted with an electrical device, such as a blender, food processor, model train, race car, fan, or vibrating pillow, to name just a few. Because most of these items are electrical, it is necessary to use a special device that connects the switch to the appliance. Steven Kanor and AbleNet are two companies that make such safety devices, which eliminate the risk of electrical shock. Toys adapted for switches, small electrical devices, and microswitches are available from many vendors, including Don Johnston; TASH, Inc.; and AbleNet.

Through a combination of microswitches, a computer, and an environmental control system, all electrical appliances in a house can be turned on and off with the activation of a single switch. This is ideal for a person with severe physical disabilities. Lamps, TVs, stereo systems, automatic door locks, and even thermostats can be controlled. This type of system offers a level of independence that previously was unavailable.

### Communication

A great many people with severe or profound disabilities are nonverbal or have severe speech impairments. Augmentative and alternative communication (AAC) refers to devices or techniques that enhance or supplement speech, to achieve goals such as the following:

- Enhanced daily communication.
- Comprehension of language.
- Facilitation of the development or return of natural speech and spoken language comprehension.
- Development of communication skills.
- Increased access to basic human interaction.

Technology provides many enhanced AAC devices to help people achieve these goals. Features now available to users include spoken and written output, rate-enhancement techniques, and access to large vocabularies. In addition, these devices can be customized, can be portable, and can accept almost any method of access to the device itself. Studies have shown, however, that there is still much to learn about how to teach people to effectively use AAC devices.

Several devices assist individuals with expressive communication disorders. Most of these devices produce some type of speech output. For example, when the user touches the pressure-sensitive surface of the *IntroTalker* or *Wolf*, the device responds auditorially with a preprogrammed sound, word, phrase, or sentence. The same output can be accessed from similar devices, (*LightTalker* and *Scan Wolf*), through the use of a microswitch. Some devices interface with a computer, providing access to word processors, databases, spreadsheets, telecommunication, and games. The portability and power of laptop computers is making it possible to combine a computer and communication device in one small package.

### Socialization

Because much of the educational program is highly individualized, the social skills of students with severe disabilities frequently do not receive adequate attention. Yet social situations prevail in educational settings and provide opportunities for abundant intrinsic learning opportunities. Computer technologies provide the

potential for training students to be active participants in social settings. Because the technology can accept a variety of individual responses, many people with a broad set of skills can participate in a single activity.

Using computer-based games, students can learn turn-taking skills, group cooperation skills, and the joy of being part of a group. Many simple games are available from the LAUSD/UCLA Early Intervention Project, which focuses on the social skill development of young children with disabilities. For older students, off-the-shelf games can be accessed through keyboard emulators such as the *Adaptive Firmware Card* or *PC Aid*.

Interactive group activities can also be set up without the computer using the switch technologies. For example, an electric train can be "passed" from student to student. In this activity, each student has a switch that controls a specific section of track (Keefe, Rosenberg, Boyd, & Hutinger, 1990). Social skill development opportunities are unlimited given the creative thinking of teachers.

### Summary

Motor skills, mobility, environmental control, communication, and socialization are all skills that enhance an individual's opportunities and success in participating in the educational process. New technologies are providing new potential to achieve higher skill levels. With these increased abilities, students with severe or profound disabilities are becoming even more ready to participate in more formal instruction.

## Technology to Deliver Instruction

The learning styles and capabilities of people with severe or profound disabilities vary even more than their physical and sensory abilities. Language and attention deficits are two prevalent learner characteristics. Language deficits typically result from auditory processing, verbal memory, and verbal problem-solving deficits or delays. Attention deficits are noted in students' ability to attend to only one dimension of a stimulus complex—often the incorrect one.

### Information Feedback and Reinforcement

These learner characteristics suggest that specific prompting strategies need to be employed to teach students with severe disabilities how to focus attention on the critical features of the stimulus presented. Additional cues that exaggerate or draw attention to the critical features should be used during early instruction and then faded in a systematic manner. These cues may be placed close to the training stimulus during the early stages of instruction and gradually made more distant. Animation of the critical features may also be used, that present sequences of positive and negative examples of the concept to be learned.

Systematic reinforcement of correct responses is a vital component in the instruction of people with severe cognitive disabilities. However, due to their limited response repertoires and limited opportunities to interact because of sensory, motor, and cognitive impairments, it is often difficult to determine what the reinforcers are. As noted earlier, people with disabilities do have the ability to indicate preferences, and it is important to "listen" to what is being said. It must be understood, however, that reinforcers can fluctuate. Satiation on one reinforcer can easily occur, especially if overused. For some reason, what worked on one day may not work on another. Being perceptive to these changes is critical.

To be effective, reinforcers should be presented immediately following the correct response. Most computer systems cannot activate the reinforcer fast enough to meet this requirement, so an auditory signal is often used as the immediate reinforcer, followed by the principal or true reinforcer. This principal reinforcer can then serve as the discriminative stimulus for the next response, creating a behavioral chain. Feedback for any incorrect response should not reinforce the wrong response, but should encourage continued attention to the task.

These principles of good instruction provide guidelines for evaluating and authoring software for the classroom. The computer is capable of systematically changing the presentation of cues and delivering reinforcements. It is also capable of collecting accurate and complete response data to allow the teacher to modify the instruction when the current strategy or reinforcer does not work. One authoring program, *MACS I*, has been especially designed for students with severe disabilities and provides the teacher with control over many of these instructional variables.

### Graphics

Many students with cognitive disabilities lack abstraction capabilities and have difficulties with visual closure; that is, they cannot visualize a complete figure from a fragmented one. These findings have strong implications for the types of materials presented to these students, including information presented on a computer screen, on videotapes, and on interactive videodiscs.

Despite these limitations, graphics are being incorporated into the following technology applications:

- Computer-assisted instruction frequently uses graphics to provide drill and practice in vocabulary, premath, and early cognitive skills.
- More elaborate uses of graphics are used to present the learner with simulated experiences, such as negotiating city streets and pouring liquids into containers.
- In alternative and augmentative communication systems, pictures are used to represent simple to complex communication segments. When paired with written or spoken language, these pictures become the student's communication repertoire.
- Graphics are used to cue individuals for the correct response or to train attention to the critical features of the stimulus.

- Graphics are used as reinforcers, with no additional meaning or value attached to them.

In all applications, however, one is never sure of what the individual is seeing and what information is being gained. Some people with severe disabilities may see only splashes of color and movement and may not comprehend the intended meaning of the graphic. Teachers must use caution in assuming too much and attributing qualities to graphic materials that may not exist. Another constraint to the use of high-quality graphics technologies is their high cost. They will, however, come down in price in the future and become more commonplace in the classroom. It is only a matter of time before many graphics applications—at lower cost—will be developed for students with severe or profound disabilities.

### Speech Technologies

Like graphics, very little is known about how people with severe cognitive disabilities perceive computer-based speech.

There are two types of computer-based speech production commonly used today— speech synthesis and digitized speech. Speech synthesis incorporates speech rules to translate written language into spoken language. The English language has far too many rules and exceptions to those rules for any current speech synthesis system to handle successfully. As a result of this limitation, speech from such a system is far from perfect, typically sounding robotlike, and containing many mispronunciations. Digitized speech, on the other hand, is digitally recorded human speech, which, when "played back," produces humanlike speech output. The limitation of this type of speech is that it requires individual words or phrases to be recorded, which are then patched together to make sentences. This technique produces slow and choppy speech. The recording and storage of enough vocabulary to make a system flexible and more useful requires significant computer memory and thus is considerably more costly.

Despite the limitations of currently available speech technologies, they are being used in many instructional applications for students with severe disabilities. Speech output is often incorporated into computer-assisted instruction programs; for example, in the early language programs from Laureate Learning Systems. Though it is unknown if students really understand the words being spoken, it is thought that the auditory signal may serve as a cue for responding. Another instructional application uses speech as a reinforcer. A correct response can elicit a spoken response, which is highly reinforcing to many people. The *MACS I* authoring software lets one program phrases like "Very good" and "That's great" in response to a correct answer. A common, but noninstructional, application is the provision of speech output for nonverbal individuals.

### Summary

To be able to incorporate these technological applications, teachers need software and hardware that can be customized to meet individual needs. The following characteristics are desirable:

1. The ability to select and create individualized outputs to activate a wide variety of reinforcers.
2. "Smart" software that helps the teacher select good reinforcers, monitor performance, and suggest revisions when necessary.
3. Embedded expert systems to assist with the recording and analyzing of student errors.
4. Greater control over computer-generated prompting techniques, providing methods for selecting and evaluating prompting strategies.

Recommendations for their inclusion in products have been made by researchers, but to date they are not commonly available.

## Conclusion

The computer and technology applications for people with severe or profound disabilities discussed in this guide are by no means complete. Advancements in technology are occurring rapidly and offer these people new opportunities every day. It is important to remember that computers and other technological materials are tools, and they should be used in whatever manner best meets the individual's needs and offers him or her the greatest level of independence possible.

With higher-powered computers and the newer video-based technologies, exciting instructional applications will become more available. However, there are still many issues and ethical concerns to be considered when using technology with students with severe and profound disabilities. These include weighing the cost of the technology against its effectiveness in bringing the individual to a higher level of independence. There are many costs involved. Beyond the purchase of the equipment, professionals and caregivers have to be trained, and equipment has to be maintained and upgraded periodically. The issue of who should pay for these benefits has not been adequately answered. If an agency such as the school pays, who owns the technology? Does it move with the student through the educational system? Can it be brought home? Many districts have developed policies to address these concerns, and federal legislation is assisting states with these issues. However, these issues must still be addressed before implementing technology with persons with severe disabilities.

## Readings

Brinker, R. P., & Lewis, M. (1982). Making the world work with microcomputers: A learning prosthesis for handicapped infants. *Exceptional Children*, 49(2), 163-170.

Burkhart, L. J. (1987). *Using computers and speech synthesis to facilitate communicative interaction with young or severely handicapped children*. College Park, MD: Author.

Gerstein, R. M., White, W. A. T., Falco, R., & Carnine, D. (1982). Teaching basic discriminations to handicapped and non-handicapped individuals through a dynamic presentation of instructional stimuli. *Analysis and Intervention in Developmental Disabilities, 2*, 305-317.

Hofmeister, A. M., Engelmann, S., & Carnine, D. (1986). Videodisc technology: Providing instructional alternatives. *Journal of Special Education Technology*, 7(3), 35-41.

Hoover, J., Reichle, J., VanTasell, D., & Cole, D. (1987). The intelligibility of synthesized speech: Echo II versus Votrax. *Journal of Speech and Hearing Research, 20*, 425-431.

Kannenberg, P., Marquardt, T. P., & Larson, J. (1988). Speech intelligibility of two voice output communication aids. *Journal of Communication Disorders, 21*(1), 11-20.

Keefe, J., Rosenberg, S., Boyd, J., & Hutinger, P. (1990). It's my turn!: Using computer-controlled toys to teach complex relationships. *DEC Communicator, 16* (4).

Kraat, A. (1985). *Communication interaction between aided and natural speakers: A state of the art report*. Toronto: Canadian Rehabilitation Council for the Disabled.

Lahm, E. A. (Ed.). (1989). *Technology with low incidence populations: Promoting access to education and learning*. Reston, VA: Council for Exceptional Children, Center for Special Education Technology.

Mitchell, P. R., & Atkins, C. P. (1989). A comparison of the single word intelligibility of two voice output communication aids. *Augmentative and Alternative Communication, 5*(2), 84-88.

Paske, R. (1990). Hypermedia: A progress report. Part 3: CD-ROM, CD-I, DVI, etc. *T.H.E. Journal, 18*(3), 93-97.

P.L. 100-407, The Technology-Related Assistance for Individuals with Disabilities Act, 1988.

Rosenberg, S. A., & Robinson, C. C. (1985). *Development of a microprocessor based work station for severely/profoundly multiply handicapped*, (Grant No. G008300312). Washington, DC: Office of Special Education Programs, U. S. Department of Education. (ERIC Document Reproduction Service No. ED 261 492)

Rushakoff, G., & Lombardino, L. (1983). Comprehensive microcomputer applications for severely physically handicapped children. *Teaching Exceptional Children, 16*, 18-22.

Sandler, A. G., & McLain, S. C. (1987). Sensory reinforcement: Effects of response-contingent vestibular stimulation on multiply handicapped children. *American Journal of Mental Deficiency, 91*(4), 373-378.

Steinberg, B. (1974). Information processing in the third year: Coding, memory, transfer. *Child Development, 45*, 503-507.

Wacker, D. P., Berg, W. K., Wiggins, B., Muldoon, M., & Cavanaugh, J. (1985). Evaluation of reinforcer preferences for profoundly handicapped students. *Journal of Applied Behavior Analysis, 18*, 173-178.

Wilson, J. (1990). Hypergraphics: "The classroom of the future." *T.H.E. Journal, 17*(7), 65-70.

Wolfe, V. F., & Cuvo, A. J. (1978). Effects of within-stimulus and extra-stimulus prompting on letter discrimination by mentally retarded persons. *American Journal of Mental Deficiency, 83*, 197-203.

Wright, C., & Nomura, M. (1985). *From toys to computers: Access for the physically disabled child* (rev. ed.). San Jose, CA: Author.

## Resources—Organizations

Association for Retarded Citizens, Bioengineering Program, 2501 Ave. J, Arlington, TX 76006.

RESNA, 1101 Connecticut Ave. NW, Suite 700, Washington, DC 20036; 202/857-1199.

TRACE Research and Development Center, S-151 Waisman Center, University of Wisconsin-Madison, 1500 Highland Ave., Madison, WI 53705; 608-262-6966.

United States Society for Augmentative and Alternative Communication, Judy Montgomery, President, Fountain Valley School District, 17210 Oak St., Fountain Valley, CA 92708; 714/857-1478.

## Resources—Periodicals

*Assistive Technology*, RESNA, 1101 Connecticut Ave. NW, Suite 700, Washington, DC 20036; 202/857-1199.

*Augmentative and Alternative Communication* (Journal), Williams & Wilkins, Publisher, 428 E. Preston St., Baltimore, MD 21202-3933.

*Journal of Special Education Technology*, Peabody College of Vanderbilt University, Box 328, Nashville, TN 37203.

## Resources—Products

### Microswitches, Computer Interfaces, and Environmental Control

AbleNet, AccessAbility, Inc., 1081 10th Ave. SE, Minneapolis, MN 55414; 612/379-0956.

Don Johnston Developmental Equipment, Inc., P.O. Box 639, 1000 North Rand Blvd., Bldg. 115, Wauconda, IL 60084; 708/526-2682.

Steven E. Kanor, PhD, Inc., 8 Main St., Hastings-on-Hudson, NY 10706; 914/478-0960.

TASH, Inc., 70 Gibson Dr., Unit 12, Markham, ON Canada L3R 4C2; 416/475-2212.

### Augmentative Communication

*IntroTalker, LightTalker*: Prentke Romich Company, 1022 Heyl Rd., Wooster, OH 44691; 216/262-1984.

*Wolf, ScanWolf*; AdamLab, Wayne County Intermediate School District, 33500 Van Born Rd., Wayne, MI 48184; 313/467-1415.

### Software

*Joystick Trainer*, R.J. Cooper & Associates, 24843 Del Prado, Suite 283, Dana Point, CA 92629; 714/240-1912.

*Letter Recognition*, Hartley Courseware, Inc., P.O. Box 419, Dimondale, MI 48821; 800/247-1380, 517/646-6458.

*Motor Training Games*, Don Johnston Developmental Equipment, Inc., P.O. Box 639, 1000 Rand Rd., Bldg. 115, Wauconda, IL 60084-0639; 800/999-4660.

UCLS/LAUSD Intervention Project, 1000 Veteran Ave., 23-10 Rehab, Los Angeles, CA 90024. Attention: Kit Kehr.



**Tech Use Guides** on the following topics are available from the Center upon request:

Augmentative and Alternative Communication
Computer Access
Computers and Cooperative Learning
Computers and Writing
Emotional and Behavioral Disorders
Guide for Parents
Guide for Teachers
Hearing Impairments
Learning Disabilities
Mildly Handicapped
Preschool Children
Role of the Speech Therapist
Selecting Software
Severe and Profound Disabilities
Speech Technologies
Technology for Work, Home, and Leisure
Telecommunication Networks
Visual Impairments

This material was developed by the Center for Special Education Technology under Contract No. 300-87-0115 with the Office of Special Education Programs, U.S. Department of Education. The content, however, does not necessarily reflect the position or policy of OSEP/ED and no official endorsement of the material should be inferred.